SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-40

Name: Angostura Reservoir County: Fall River
Legal description: T 8S, R 5,6 E Sec. 1-12,17,19, 20, 21, 28-33
Location from nearest town: 7 miles southeast of Hot Springs, SD.
Dates of present survey: July 26, August 14-16, 2007
Date last surveyed: August 4, 14-16, 2006
Most recent lake management plan: F21-R-37 Date: 2005
Management classification: Warmwater permanent Contour mapped: 1985

Primary Species: (game and forage)
1. Walleye
2. Channel catfish
3. Smallmouth bass
4. Gizzard shad
5. Largemouth bass
6. Black crappie
7. Spottail shiner
8. Emerald shiner

Secondary and other species:
1. Bluegill
2. Common carp
3. Green sunfish
4. Northern pike
5. Northern redhorse
6. River carpsucker
7. White sucker
8. Yellow perch
9. Freshwater drum

PHYSICAL CHARACTERISTICS

Surface Area: 4,612 acres; Watershed: 5,824,000 acres
Maximum depth: 70 feet; Mean depth: 29.3 feet
Lake elevation at survey (from known benchmark): unknown

1. Describe ownership of lake and adjacent lakeshore property:

The U.S. Bureau of Reclamation performs the maintenance of Angostura Reservoir and Dam. The South Dakota Department of Game, Fish and Parks manages much of the adjacent land as a recreation/campground area and game production area. The local irrigation district controls the water level and irrigation releases.

2. Describe watershed condition and percentages of land use:

The Angostura Reservoir watershed consists of approximately 9,100 square miles of livestock pastureland. Ownership of the watershed is predominately private with a small portion in Buffalo Gap National Grassland.

3. Describe aquatic vegetative condition:

Little precipitation throughout 2007 along with heavy irrigation left Angostura with low water levels. Emergent vegetation was left high and dry. Submergent vegetation, mostly Curlyleaf

pondweed *Potamogeton crispus*, was observed in the bays and shallow water areas of Angostura during the 2007 lake survey and appears to be increasing in abundance over previous years.

4. Describe pollution problems:

Department personnel identified no pollution problems during the 2007 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

No apparent problems were identified on either the dam or spillway. Most of the boat ramps and other facilities were in good condition, though low water levels had all but one ramp unusable by late summer.

BIOLOGICAL DATA

Methods

A lake survey was conducted on Angostura Reservoir August 14-16, 2007. Sampling consisted of 4 gill net nights and 8 trap net nights (Appendix C). All gill nets were monofilament experimental 150 foot nets. The switch from 300 foot gill nets was to get better confidence in our catch rate data. The gill nets were monofilament, experimental net 45.7 m (150-ft) long and 1.8 m (6-ft) deep with six 7.6 m (25-ft) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). Trap nets were set at eight stations consisting of 1 trap net nights each. Standard locations had to be adjusted due to very low water levels. All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1-mm (¾-in) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE; number of fish collected per net night or number of fish collected per hour of electrofishing), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch-per-unit-effort (CPUE; mean number per net night). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr for stock length and larger fish.

Results and Discussion

Age-0 Fish Survey

Day electrofishing was added in 2004 in attempt to increase our understanding and sample sizes concerning shad reproduction. Ten sampling runs were accomplished during July 26, 2007 (Table 1). Three runs were completed in the Horsehead area, 3 runs in the Cheyenne Arm, 2

runs in the Sheps Canyon area near the dam, and 2 runs in the middle of the reservoir (Mid Zones). A total of 1,968 young of the year gizzard shad were captured in 0.92 hours of electrofishing and nine of the ten sites sampled had shad indicating good reproduction in 2007. In 2006, a total of 381 young shad were captured in 0.92 hours of electrofishing with nine of the ten sites having shad.

Table 1. Daytime electrofishing results from Angostura Reservoir, July 26, 2007.

Site	No./Site	Time (sec)	No./hr
1	109	300	1308
2	68	300	816
3	0	600	0
4	6	300	72
5	250	300	3000
6	190	300	2280
7	1000	300	12000
8	30	300	360
9	75	300	900
10	240	300	2880
Total	**1968**	**0.92 hours**	**2361.6**

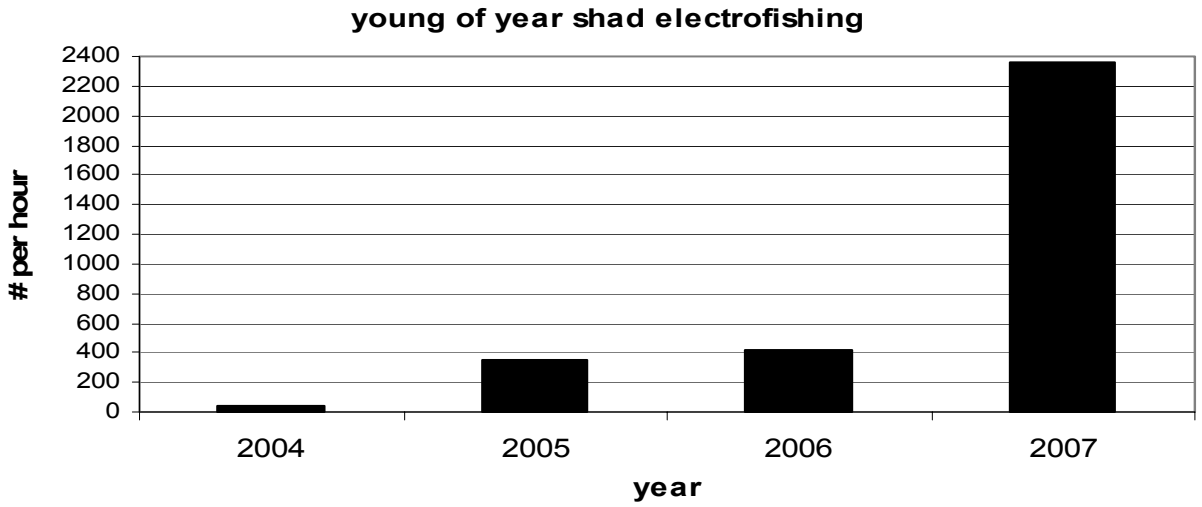

Figure 1. Daytime electrofishing results for young of year gizzard shad from 10 sites in Angostura 2004-2007.

Fish Community Survey

Eleven species were collected in both gill nets and trap nets during the 2007 lake survey of Angostura Reservoir. Eight species, totaling 341 fish, were collected in four experimental gill nets (Table 2). Channel catfish (40.5%) were the most common species collected with walleye (24.0%) being the second most common. Other species collected in gillnets were black crappie, common carp, freshwater drum, gizzard shad, river carpsucker and yellow perch.

Nine species, totaling 114 fish, were collected in trap nets during the 2007 survey. Channel catfish (36.0%) were the most common fish collected and black crappie (20.2%) the second most common (Table 3). Other species collected were bluegill, freshwater drum, gizzard shad, river carpsucker, shorthead redhorse, smallmouth bass and walleye.

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% CI's in parentheses), and fish condition for fish larger than stock-length (Wr>S; 90% CI's in parentheses) for all fish species collected from four, 150-ft experimental sinking gill nets in Angostura Reservoir, Fall River County, August 14-16, 2007.

. **Species**	**N**	**CPUE**	**CPUE-S**	**PSD**	**RSD-P**	**Wr>S**
Black crappie	6	1.5 (2.0)	1.3 (1.6)	--	--	120.6 (--)
Channel catfish	138	34.5 (7.5)	10.0 (4.6)	10 (8)	3 (4)	80.9 (0.9)
Common carp	22	5.5 (4.1)	5.5 (4.1)	36 (18)	0 (--)	--
Freshwater drum	46	11.5 (4.8)	8.5 (4.1)	12 (10)	0 (--)	89.6 (0.7)
Gizzard shad	11	2.8 (4.0)	--	--	--	--
River carpsucker	34	8.5 (2.5)	8.5 (2.5)	97 (5)	97 (5)	--
Walleye	82	20.5 (4.0)	20.5 (4.0)	23 (8)	5 (4)	83.3 (0.7)
Yellow perch	2	0.5 (0.5)	0.5 (0.5)	--	--	88.6 (13.5)
Totals	341					

Table 3. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and fish condition for fish larger than stock-length (Wr>S; 90% CI's in parentheses) for all fish species collected from 8 modified-fyke trap nets in Angostura Reservoir, Fall River County, August 14-16, 2007.

Species	**N**	**CPUE**	**CPUE-S**	**PSD**	**RSD-P**	**Wr>S**
Black crappie	23	2.9 (0.9)	2.3 (0.9)	39 (20)	11 (13)	99.6 (1.7)
Bluegill	17	2.1 (1.6)	2.1 (1.6)	53 (22)	0 (--)	96.9 (1.8)
Channel catfish	41	5.1 (2.0)	--	--	--	--
Freshwater drum	1	0.1 (0.2)	--	--	--	--
Gizzard shad	1	0.1 (0.2)	--	--	--	--
River carpsucker	14	1.8 (1.0)	0.3 (0.2)	--	--	--
Shorthead redhorse	4	0.5 (0.4)	0.4 (0.4)	--	--	--
Smallmouth bass	7	0.9 (0.6)	0.8 (0.4)	--	--	94.0 (2.8)
Walleye	6	0.8 (0.7)	0.8 (0.7)	--	--	81.4 (3.6)
Totals	114					

Black crappies

Black crappie abundance decreased from last year with a frame net CPUE of 2.9 (Table 4). It should be noted that trap nets could not be set in normal locations because of very low water. PSD was higher at 39 while RSD-P rose slightly to 11. Mean condition of frame net black crappie greater than stock length was good with a Wr of 99.6 (Table 3). The length frequency histogram for 2007 shows a good number of age one fish in the 130 to 140 millimeter range, similar to last year (Figure 2). Growth was excellent as shown in table 5.

Table 4. Composite listing of sample size (N), catch per unit effort (CPUE; 80% confidence intervals are given in parentheses), catch per unit effort of stock length fish (CPUE-S; 80% CI's are given in parentheses), and proportional stock densities (PSD, RSD; 90% CI's are given in parentheses) for black crappie collected by trap nets in Angostura Reservoir, 2001-2007.

Year	N	CPUE	CPUE-S	PSD	RSD-P
2001	22	1.8 (1.7)	1.6 (1.6)	79 (17)	63 (20)
2002	33	3.0 (1.3)	1.9 (1.0)	52 (20)	29 (18)
2003	30	2.7 (0.9)	2.0 (0.7)	55 (19)	14 (13)
2004	15	1.9 (1.6)	0.6 (0.5)	40 (52)	20 (43)
2005	87	10.9 (7.5)	10.5 (7.3)	69 (8)	6 (4)
2006	40	5.0 (1.9)	4.0 (1.6)	19 (12)	6 (8)
2007	23	2.9 (0.9)	2.3 (0.9)	39 (20)	11 (13)

Table 5. Angostura Reservoir black crappie year class, age in 2007, sample size (N), mean back-calculated total length-at-age, population standard error (SE).

Year Class	Age	N	Age 1	2	3	4
2006	1	16	72			
2005	2	5	76	178		
2004	3	1	76	165	243	
2003	4	1	82	147	241	268
Sample size		**23**				
Mean (SE)			76 (2)	163 (9)	242 (1)	268 (0)
Region 1			74 (3)	122 (7)	158 (9)	
SD mean			83 (2)	147 (4)	195 (5)	

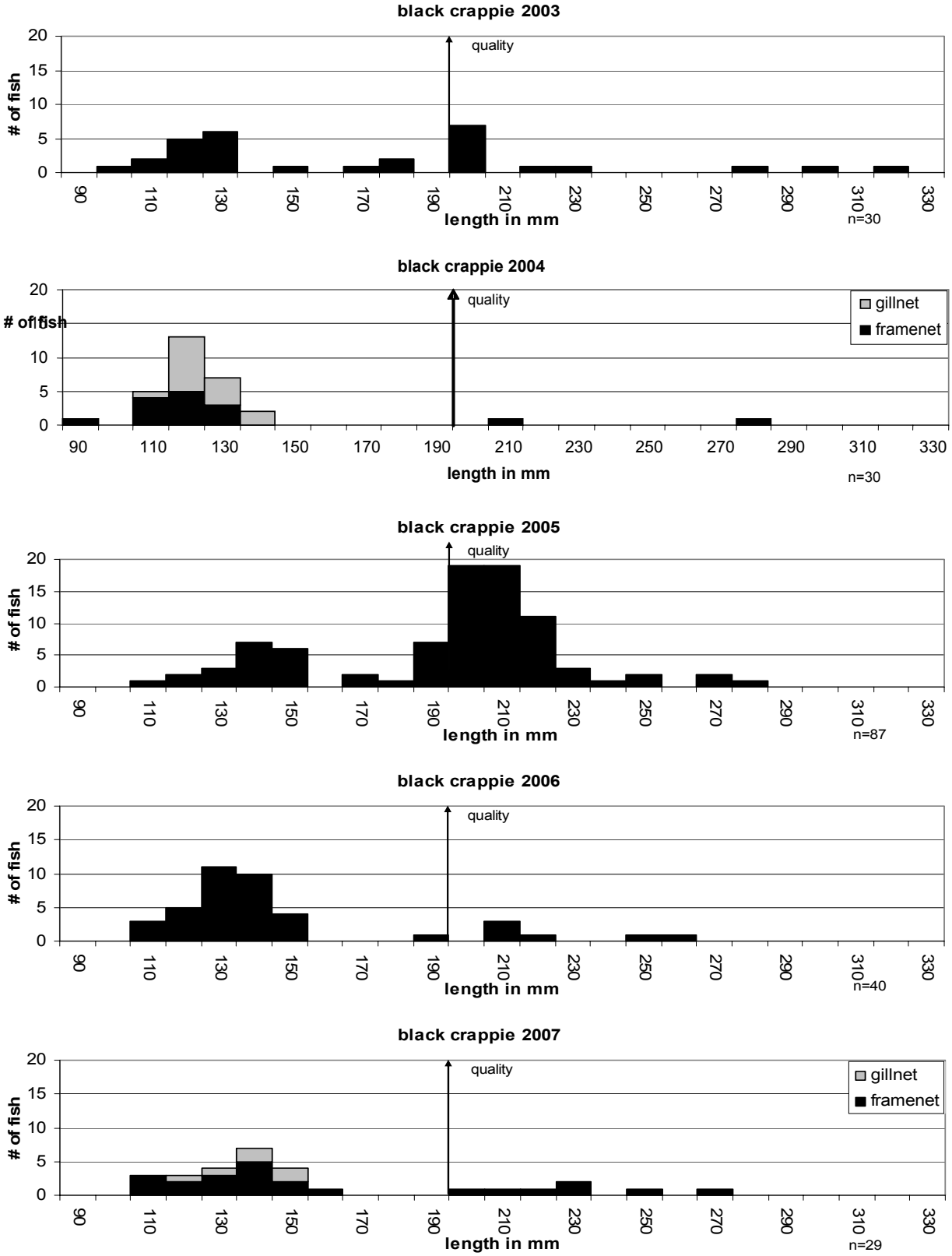

Figure 2. Length histogram of black crappies collected from Angostura Reservoir, Fall River County 2003-2007.

Channel Catfish

Channel catfish were the most abundant fish collected in gill nets and trap nets (Tables 2 and 3). Gill net mean CPUE for all catfish was 34.5, and for fish stock length and greater the mean CPUE was 10.0 which is slightly lower than last year (Table 6). Stock density indices remain very low; PSD=10, RSD-P=3. Mean Wr for stock length and larger catfish dipped to 80.9 (Table 3).The length frequency histogram (Figure 3) shows few catfish over 300 mm. There appears to be a large year class stalled out at around 260mm, which has moved very little over the past four years.

During the springs of 2004-2006, Angostura was used as a source for channel catfish and small adult catfish were removed and stocked into other South Dakota waters. Plans are to continue using this reservoir as a stocking source for other waters over the next couple of years. Whether or not the removals will have an affect on size structure and density of the population remains to be seen.

Table 6. Composite listing of sample size (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80% CI's in parentheses) and proportional stock densities (PSD, RSD; 90% CI's in parentheses) for channel catfish collected by gillnets in Angostura Reservoir, 1997-2007.

Year	N	CPUE	CPUE-S	PSD	RSD-P
1997	89	29.7 (35.9)	14.0 (14.6)	22 (6)	1 (1)
1998	52	17.3 (16.6)	10.4 (11.0)	10 (5)	2 (3)
2000	483	96.6 (33.1)	50.8 (17.1)	20 (4)	3 (2)
2001	339	67.8 (49.2)	31.4 (26.3)	20 (6)	2 (2)
2002	351	87.8 (29.8)	15.5 (17.8)	3 (4)	0 (--)
2003	233	58.3 (26.4)	16.5 (6.0)	8 (6)	0 (--)
2004	462	115.5 (51.7)	38.0 (17.2)	14 (5)	0 (--)
2005	171	85.5 (97.0)	21.5 (10.8)	5 (5)	0 (--)
2006*	170	42.5(12.3)	14.3(4.2)	5(5)	0(--)
2007*	138	34.5(7.5)	10.0(4.6)	10(8)	3(4)

*150' gillnets instead of 300' gillnets.

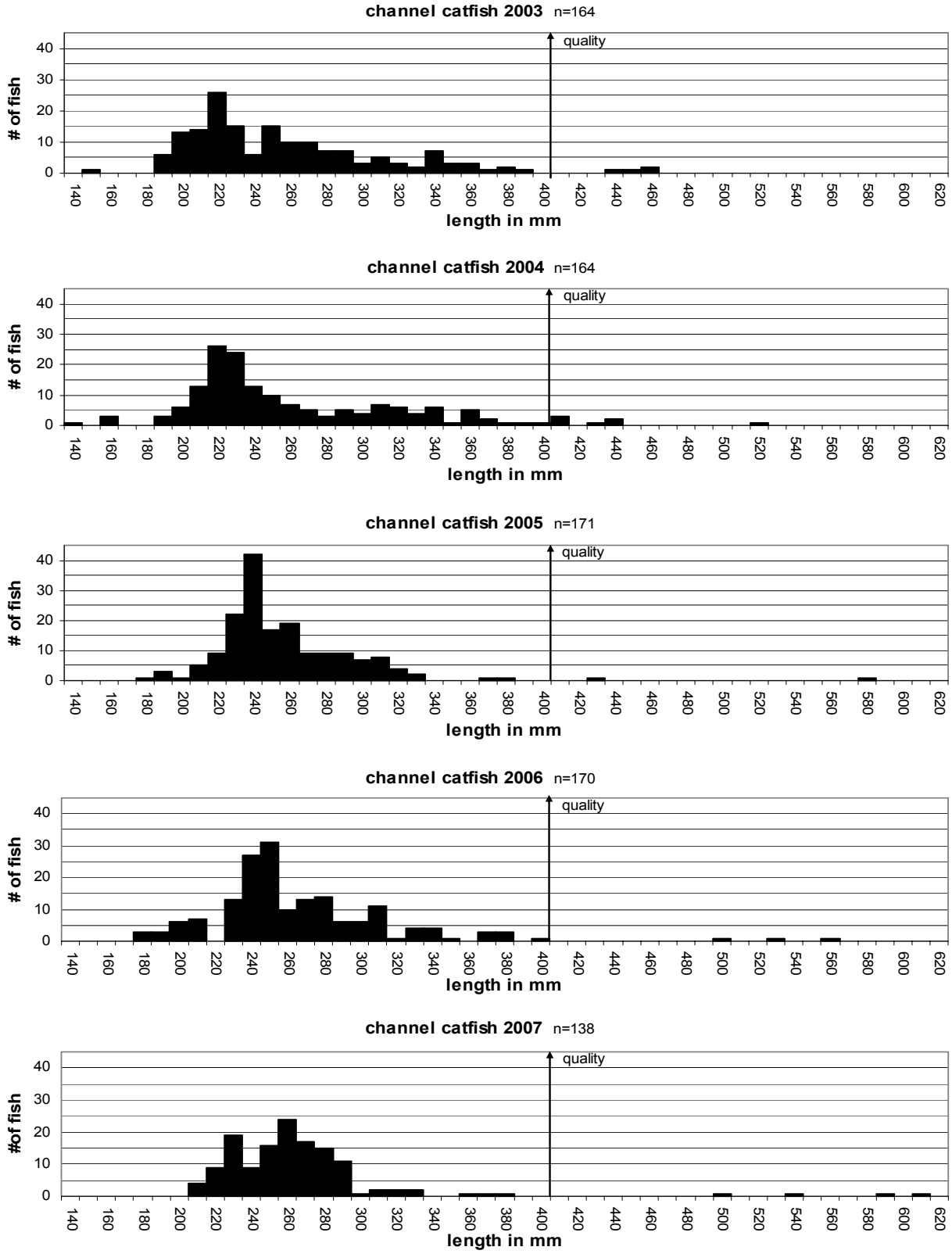

Figure 3. Length frequency histogram of channel catfish collected in gill nets from Angostura Reservoir, Fall River County, 2003-2007.

Gizzard shad

Gizzard shad were introduced to Angostura Reservoir in 1990 to provide forage for game fish, especially walleye, which were experiencing slow growth, poor condition and high mortality. The first age-0 gizzard shad were collected in 1994 during the ¼ arc seine survey. No adult gizzard shad have been stocked in Angostura Reservoir since 1994. No adult shad have been collected in the past two surveys. A total of 1,968 young of the year gizzard shad were captured in 0.92 hours of electrofishing and nine of the ten sites sampled had shad indicating good reproduction in 2007. This is the most fish sampled in the four year history of daytime electrofishing (Figure 1)

The northern latitude of South Dakota and subsequent cold winter water temperatures most likely causes some over-winter mortality of gizzard shad on an annual basis. Limited winter mortality of gizzard shad is desirable to keep densities of adult shad low while maintaining a high reproductive potential. Due to the continued presence of age-0 shad and adults during annual gill net sampling, it is apparent that some survival of adult shad is occurring and the surviving adult shad can produce large year classes of juveniles.

Walleye

Angostura remains one of the most popular walleye fisheries in western South Dakota. Even with high fishing pressure, walleye abundance remains good with a gill net CPUE of 20.5 (Table 3). Last year, CPUE was a little higher at 24.5 (Table 7). CPUE, for stock length and larger fish, showed a similar pattern with a CPUE of 20.5 compared to 23.3 last year. The 2005 lake management plan sets the target walleye CPUE to be at least 20 per gillnet, which was achieved in 2007.

Stock density indices indicate a smaller proportion of quality walleye than last year and a large drop since 2005 when PSD was 56, compared to (Table 12). A PSD of 23 suggest the population may be becoming out of balance, being dominated by small fish. The current management plans goal is a PSD between 30 and 60. This the third time since 1994 that the PSD has dropped below thirty. When the large year class in the 13 to 15 inch range reaches quality next year, PSD should rebound. RSD-P remained low at 5 compared to 3 last year. In efforts to decrease the pressure on larger walleye, a one over 20 inch regulation was added to the 14 inch minimum. It has been questionable if this regulation will have a major impact on increasing the number of large fish since only five percent of the population is making it to 20 inches and creel data has showed that anglers target this segment of the population. At the very least this regulation will socially place a higher value on these larger walleye.

Walleye condition remained similar to last year when stock-length and larger walleye averaged 82.8. During this survey, fish condition was 83.3. Growth continues to look excellent with fish averaging well above the state average, though very few fish over 2 years old were sampled (Table 8).

Table 7. Composite listing of sample size (N), catch per unit effort (CPUE; standard error is given in parentheses), mean total length (TL; standard error is given in parentheses), and proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) for walleye collected by gill net in Angostura Reservoir, 1992-2007.

Year	N	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
1992		7.5		65	20	
1993	101	6.3		25	8	
1994		11		18	4	
1995	17	1.9		59	29	
1996	15	1.3		93	47	
1997	51	5.7		48	10	
1998	52	5.8		60	6	
2000	249	49.8 (15.5)	39.4 (14.2)	43 (6)	7 (3)	87.8 (0.5)
2001	87	17.4 (11.7)	15.4 (10.9)	31 (9)	8 (5)	87.3 (1.3)
2002	135	33.8 (19.2)	28.3 (19.4)	50 (8)	4 (3)	85.7 (0.0)
2003	117	29.3 (26.2)	23.3 (19.7)	32 (8)	2 (3)	84.6 (0.2)
2004	137	34.3 (14.1)	30.3 (13.0)	57 (8)	6 (4)	82.2 (0.4)
2005	162	81.0 (153.9)	54.5 (100.0)	56 (8)	11 (5)	86.1 (0.6)
2006*	98	24.5 (6.8)	23.3 (6.0)	27 (8)	3 (3)	82.8 (0.1)
2007*	82	20.5 (4.0)	20.5 (4.0)	23 (8)	5 (4)	83.3 (0.7)

*150 foot gillnets instead of 300 footers pre-2006.

Table 8. Angostura Reservoir walleye year class, age in 2007, sample size (N), mean back-calculated total length-at-age, population standard error (SE), the Region 1 and South Dakota walleye mean length-at-ages (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5
2006	1	9	213				
2005	2	63	224	324			
2004	3	2	179	339	398		
2003	4	3	196	317	414	465	
2002	5	2	212	343	441	489	526
Sample size		**79**					
Mean (SE)			**205 (8)**	**331 (6)**	**418 (13)**	**477 (12)**	**526 (0)**
Region 1			164 (17)	260 (22)	332 (27)	385 (32)	444 (42)
S.D. Mean			168 (3)	279 (6)	360 (7)	425 (8)	490 (9)

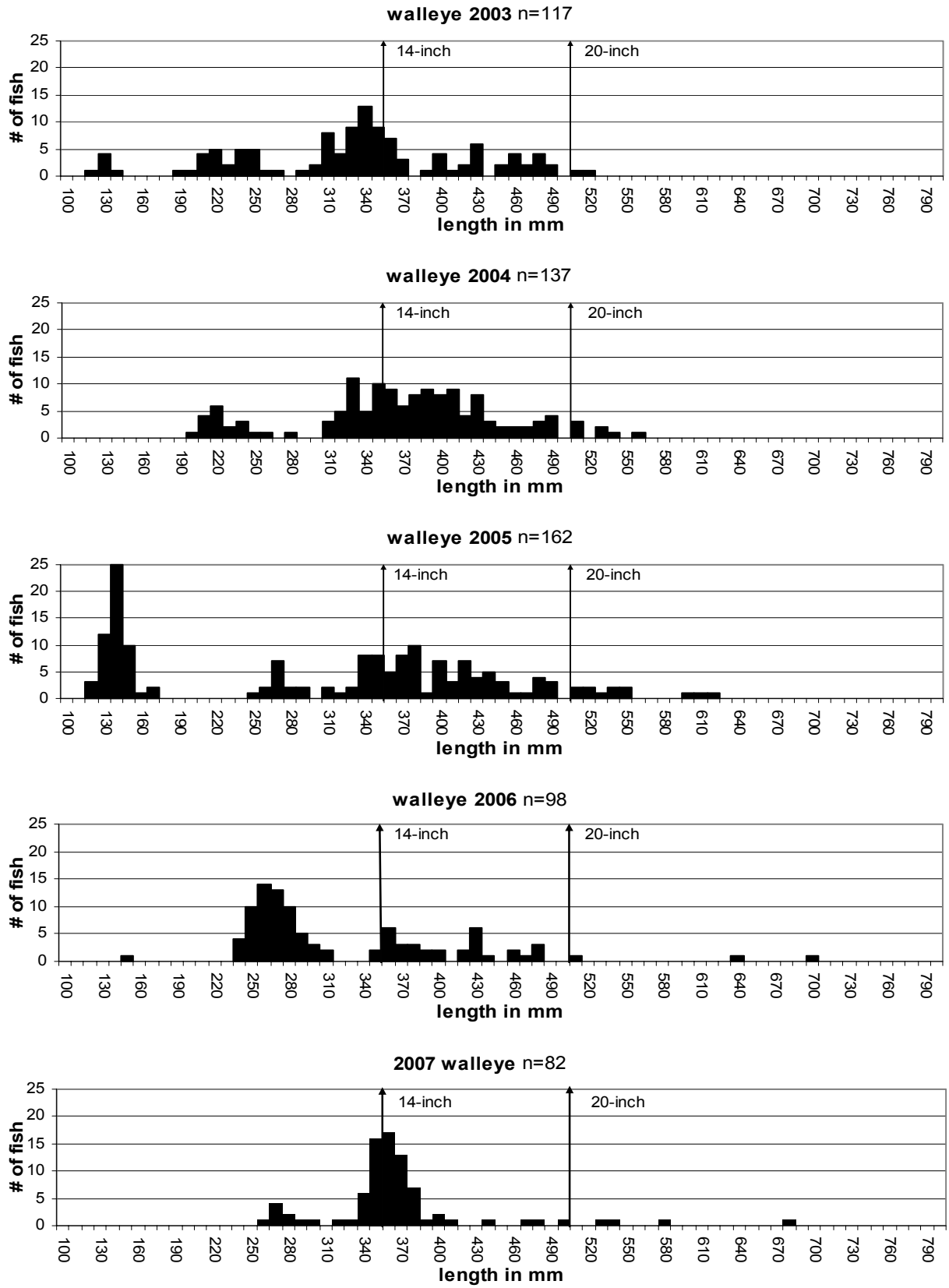

Figure 4. Length frequency histograms for walleye collected in gill nets at Angostura Reservoir, Fall River County, 2003-2007.

Yellow perch

Angostura's perch population remains low. This is probably due to high predator abundance and poor perch habitat. Gill net CPUE was 0.5 with 150 foot gill nets, compared to 2006's CPUE at 1.3. Perch condition was higher this year with a mean Wr for the two stock length and larger fish of 88.6, compared to 78.2 last year. Due to small sample size, age and growth analysis were not completed.

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Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes: A Statewide Summary with means by region and Water Type. Special Report. South Dakota Department of Game, Fish and Parks. Pierre, South Dakota.

RECOMMENDATIONS

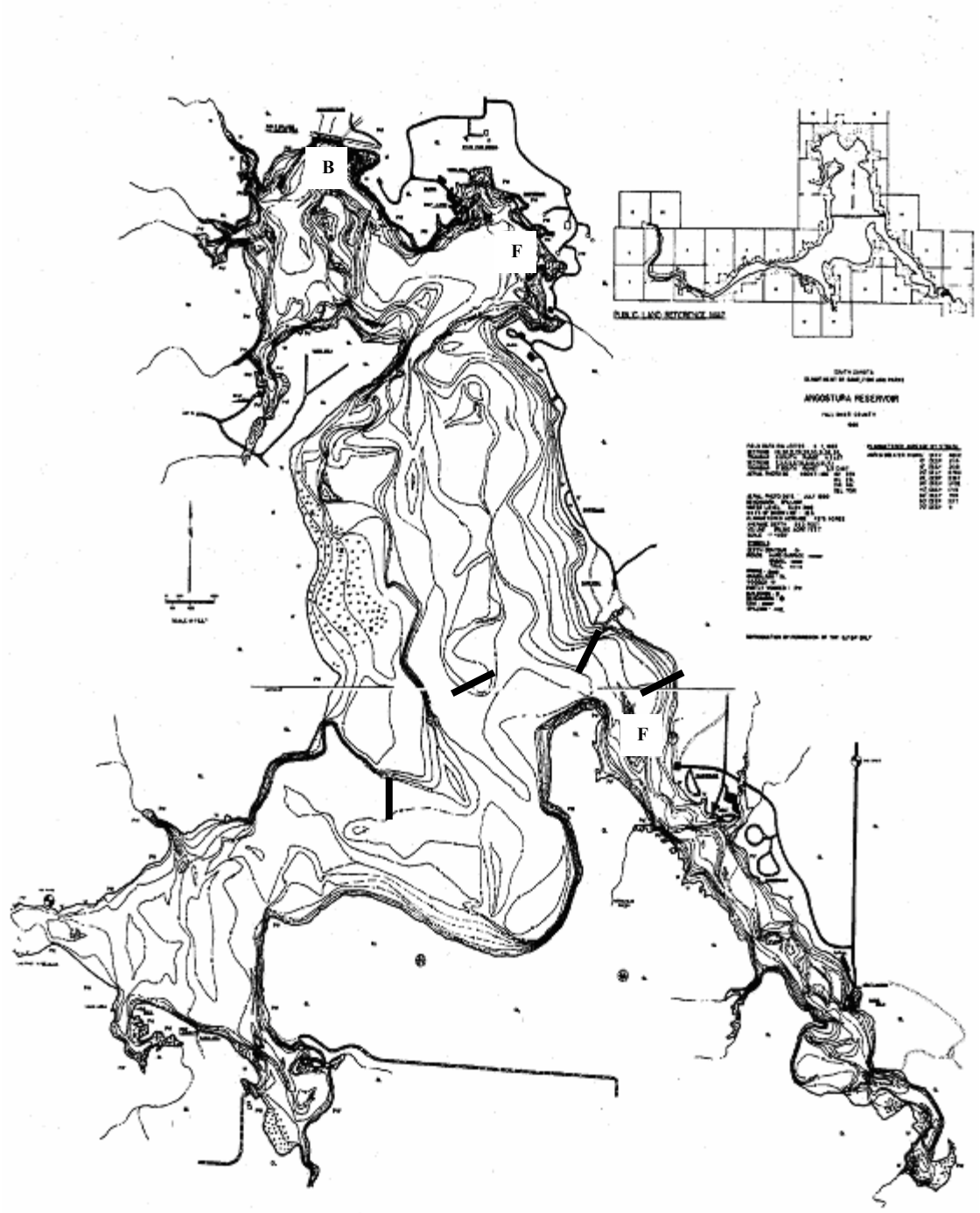
1. Continue conducting annual lake surveys to evaluate fish populations and regulation success.

2. Closely watch size structure, as PSD fell below management objectives for walleye for the second straight year. Different regulations may be required to reach management objectives because of high angling harvest.

APPENDICES

Appendix A. Stocking record for Angostura Reservoir, Fall River County, 1990-2007.

Year	Number	Species	Size
1992	300	Gizzard shad	Adult
	235,000	Walleye	Fingerling
1993	150,000	Largemouth bass	Fingerling
	235,000	Walleye	Fingerling
1994	43	Gizzard shad	Adult
	67,870	Largemouth bass	Fingerling
1995	100,000	Largemouth bass	Fingerling
	204,555	Walleye	Fingerling
1996	135,387	Largemouth bass	Fingerling
	354,070	Walleye	Fingerling
1998	109,962	Largemouth bass	Fingerling
	201,084	Walleye	Fingerling
1999	15	Gizzard shad	Adult
	48,000	Largemouth bass	Fingerling
	248,280	Walleye	Fingerling
2000	97,133	Rainbow trout	Fingerling
	207,779	Walleye	Fingerling
2001	12,638	Largemouth bass	Fingerling
	37,000	Rainbow trout	Fingerling
2002	50,100	Walleye	Fingerling
	30,000	Smallmouth bass	Fingerling
2003	218,791	Walleye	Fingerling
	80,000	Rainbow trout	Fingerling
2005	381,045	Walleye	Fingerling



B -Water chemistry sites

-Gill net locations

F -Frame net station

Appendix C. Map of Angostura Reservoir and sampling sites.